WHAT IS CLAIMED IS:

1. A process for preparing a solid composite including colloidal nanocrystals dispersed within a sol-gel host, the process comprising:

forming an admixture of colloidal nanocrystals, a lower alcohol, a non-polar co-solvent and a sol-gel precursor material; and,

forming said solid composite from said admixture.

2. The process of claim 1 wherein said colloidal nanocrystals have a volume loading of up to about 30 percent by volume within said solid composite.

3. The process of claim 1 wherein said non-polar co-solvent is selected from the group consisting of tetrahydrofuran, toluene and xylene.

4. The process of claim 1 wherein said lower alcohol is a C_1 to C_4 alcohol.

5. The process of claim 1 wherein said sol-gel precursor material is selected from the group consisting of metal alkoxide compounds, metal halide compounds, and metal hydroxide compounds where the metal is selected from the group consisting of silicon, titanium, zirconium, aluminum, vanadium, iron, tin, tantalum, cerium, and chromium.

6. The process of claim 1 wherein said colloidal nanocrystals are selected from the group consisting of M_1X_1, $M_1M_2X_1$, $M_1M_2M_3X_1$, $M_1X_1X_2$, $M_1M_2X_1X_2$, $M_1M_2M_3X_1X_2$, $M_1X_1X_2X_3$, $M_1M_2X_1X_2X_3$, and $M_1M_2M_3X_1X_2X_3$, where M_1, M_2, and M_3 are each selected from the group consisting of Zn, Cd, Hg, Al, Ga, In, Tl, Pb, Sn, Mg, Ca, Sr, Ba, mixtures and alloys thereof and X_1, X_2, and X_3 are each selected from the group consisting of S, Se, Te, As, Sb, N, P, mixtures and alloys thereof, Si, Ge, Au, Ag, Co, Fe, Ni, Cu, Mn and alloys of Au, Ag, Co, Fe, Ni, Cu, Mn or alloy combinations thereof.

7. The process of claim 1 wherein said sol-gel host is transparent.

8. The process of claim 1 wherein said colloidal nanocrystals are uniformly dispersed within a sol-gel host.

9. A process for preparing a solid composite including colloidal nanocrystals dispersed within a sol-gel host matrix, the process comprising:

reacting colloidal nanocrystals passivated with hydrophobic ligands with a multi-functional compound of the formula X_x-(Z_n)-Y_y where X is an amino group, a thiol group, a phosphonic acid group, a phosphine oxide group, a nitrile group, a thiocyanate group, or a carboxylic acid group, x is an integer and is one or more, Z is a hydrocarbon group, a polyether group, an ethylene oxide group, a propylene oxide group or a mixture thereof, n is from 1 to 20, Y is a hydroxyl group, a carboxylic acid group, a sulfonic acid group, a phosphonic acid group, or an alkoxysilane group and y is an integer and is one or more, within a solvent to form a homogeneous colloidal nanocrystal solution including colloidal nanocrystals with at least a portion of hydroxyl-terminated, carboxylic acid-terminated groups, sulfonic acid-terminated groups, phosphonic acid-terminated groups or alkoxysilane-terminated groups thereon;

admixing the homogeneous colloidal nanocrystal solution and a sol-gel precursor material; and,

forming said solid composite from said admixture.

10. The process of claim 9 wherein said colloidal nanocrystals have a volume loading of up to about 30 percent by volume within said solid state composite.

11. The process of claim 9 wherein said sol-gel precursor material is selected from the group consisting of metal alkoxide compounds, metal halide compounds, and metal hydroxide compounds where the metal is selected from the group consisting of silicon, titanium, zirconium, aluminum, vanadium, iron, tin, tantalum, cerium, and chromium.

12. The process of claim 9 wherein said colloidal nanocrystals are selected from the group consisting of M_1X_1, $M_1M_2X_1$, $M_1M_2M_3X_1$, $M_1X_1X_2$, $M_1M_2X_1X_2$, $M_1M_2M_3X_1X_2$, $M_1X_1X_2X_3$, $M_1M_2X_1X_2X_3$, and $M_1M_2M_3X_1X_2X_3$, where M_1, M_2, and M_3 are each selected from the group consisting of Zn, Cd, Hg, Al, Ga, In, Tl, Pb, Sn, Mg, Ca, Sr, Ba, mixtures and alloys thereof and X_1, X_2, and X_3 are each selected from the group consisting of S, Se, Te, As, Sb, N, P, mixtures and alloys thereof, Si, Ge, Au, Ag, Co, Fe, Ni, Cu, Mn and alloys of Au, Ag, Co, Fe, Ni, Cu, Mn or alloy combinations thereof.

13. The process of claim 9 wherein said sol-gel host is transparent.

14. The process of claim 9 wherein said colloidal nanocrystals are uniformly dispersed within a sol-gel host.

15. Alcohol-soluble colloidal nanocrystals comprising:

a reaction product of colloidal nanocrystals and a multi-functional compound of the formula X_x-(Z_n)-Y_y where X is an amino group, a thiol group, a phosphonic acid group, a phosphine oxide group, a nitrile group, a thiocyanate group, or a carboxylic acid group, x is an integer and is one or more, Z is a hydrocarbon group, a polyether group, an ethylene oxide group, a propylene oxide group or a mixture thereof, n is from 1 to 20, Y is a hydroxyl group, a carboxylic acid group, a sulfonic acid group, a phosphonic acid group, or an alkoxysilane group and y is an integer and is one or more.

16. The alcohol-soluble colloidal nanocrystals of claim 15 wherein said colloidal nanocrystals are overcoated with said multi-functional compound of the formula X_x-(Z_n)-Y_y including functionalities selected from the group consisting of amino-hydroxyl, thiol-hydroxyl, phosphonic acid-hydroxyl, and amino-carboxylic acid.

17. The alcohol-soluble colloidal nanocrystals of claim 15 wherein said colloidal nanocrystals are overcoated with multi-functional molecules including amino-hydroxyl functionalities.

18. The alcohol-soluble colloidal nanocrystals of claim 15 wherein said colloidal nanocrystals are selected from the group consisting of M_1X_1, $M_1M_2X_1$, $M_1M_2M_3X_1$, $M_1X_1X_2$, $M_1M_2X_1X_2$, $M_1M_2M_3X_1X_2$, $M_1X_1X_2X_3$, $M_1M_2X_1X_2X_3$, and $M_1M_2M_3X_1X_2X_3$, where M_1, M_2, and M_3 are each selected from the group consisting of Zn, Cd, Hg, Al, Ga, In, Tl, Pb, Sn, Mg, Ca, Sr, Ba, mixtures and alloys thereof and X_1, X_2, and X_3 are each selected from the group consisting of S, Se, Te, As, Sb, N, P, mixtures and alloys thereof, Si, Ge, Au, Ag, Co, Fe, Ni, Cu, Mn and alloys of Au, Ag, Co, Fe, Ni, Cu, Mn or alloy combinations thereof.

19. A solid composite comprising the reaction product of (i) colloidal nanocrystals including at least a portion of hydroxyl-terminated groups, carboxylic acid-terminated groups, sulfonic acid-terminated groups, phosphonic acid-terminated groups, or alkoxysilane-terminated groups thereon and (ii) a sol-gel precursor material.

20. The solid composite of claim 19 wherein said colloidal nanocrystals have a volume loading of up to about 30 percent by volume within said solid composite.

21. The solid composite of claim 19 wherein said sol-gel precursor material is selected from the group consisting of metal alkoxide compounds, metal halide compounds, and metal hydroxide compounds where the metal is selected from the group consisting of silicon, titanium, zirconium, aluminum, vanadium, iron, tin, tantalum, cerium, and chromium.

22. The solid composite of claim 19 wherein said colloidal nanocrystals are selected from the group consisting of M_1X_1, $M_1M_2X_1$, $M_1M_2M_3X_1$, $M_1X_1X_2$, $M_1M_2X_1X_2$, $M_1M_2M_3X_1X_2$, $M_1X_1X_2X_3$, $M_1M_2X_1X_2X_3$, and $M_1M_2M_3X_1X_2X_3$, where M_1, M_2, and M_3 are each selected from the group consisting of Zn, Cd, Hg, Al, Ga, In, Tl, Pb, Sn, Mg, Ca, Sr, Ba, mixtures and alloys thereof and X_1, X_2, and X_3 are each selected from the group consisting of S, Se, Te, As, Sb, N, P, mixtures and alloys thereof, Si, Ge, Au, Ag, Co, Fe, Ni, Cu, Mn and alloys of Au, Ag, Co, Fe, Ni, Cu, Mn or alloy combinations thereof.

23. A solid composite formed by the process of claim 1.

24. The solid composite of claim 23 wherein said colloidal nanocrystals have a volume loading of up to about 30 percent by volume within said solid composite.

25. The solid composite of claim 23 wherein said sol-gel precursor material is selected from the group consisting of metal alkoxide compounds, metal halide compounds, and metal hydroxide compounds where the metal is selected from the group consisting of silicon, titanium, zirconium, aluminum, vanadium, iron, tin, tantalum, cerium, and chromium.

26. The solid composite of claim 23 wherein said colloidal nanocrystals are selected from the group consisting of M_1X_1, $M_1M_2X_1$, $M_1M_2M_3X_1$, $M_1X_1X_2$, $M_1M_2X_1X_2$, $M_1M_2M_3X_1X_2$, $M_1X_1X_2X_3$, $M_1M_2X_1X_2X_3$, and $M_1M_2M_3X_1X_2X_3$, where M_1, M_2, and M_3 are each selected from the group consisting of Zn, Cd, Hg, Al, Ga, In, Tl, Pb, Sn, Mg, Ca, Sr, Ba, mixtures and alloys thereof and X_1, X_2, and X_3 are each selected from the group consisting of S, Se, Te, As, Sb, N, P, mixtures and alloys thereof, Si, Ge, Au, Ag, Co, Fe, Ni, Cu, Mn and alloys of Au, Ag, Co, Fe, Ni, Cu, Mn or alloy combinations thereof.